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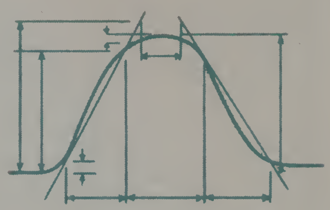
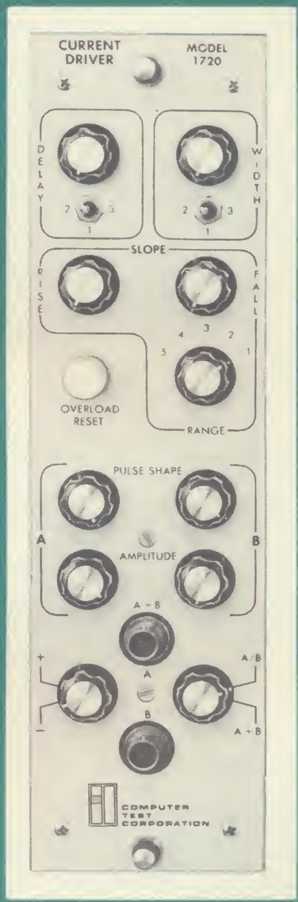




CURRENT DRIVERS/SERIES 1720

The newly developed Model 1720 Current Driver has been designed to satisfy the requirements for precise, fast current waveforms for an entirely new generation of both manual and automatic magnetics test equipment. The basic performance specifications of this driver have established a new benchmark in the demanding sub-50 nanosecond rise time speed range.

CURRENT DRIVERS/bi-polar, 10 nanoseconds

Precise current waveforms with extremely linear rise and fall

10ns Pulse width—Pulse widths to 10 nanoseconds give the 1720 comfortable margin for driving fast switching thin film devices. The driver is effectively a pulse generator with independent control of pulse width and of pulse delay after application of an input trigger pulse. Both width and delay are variable to 10 microseconds.

Linear rise & fall—Very linear rise and fall characteristics, extending into the sub-10 nanosecond region for the pulse rise identify the 1720 and make it unique in its class. Linearity of rise and fall for slopes faster than 20 nanoseconds is less than $\pm 10\%$, and for slopes slower than 20 nanoseconds is less than $\pm 2\%$. Rise and fall time are independently variable but have a common range control.

Bi-Polar output—The 1720 is a true Bi-Polar current driver, developing positive or negative current pulses, d-c referenced to ground by the simple turn of a front panel polarity switch. Pulse characteristics . . . source impedance . . . source capacitance . . . current and voltage are nearly identical in both the positive and negative modes of operation in the 1720.

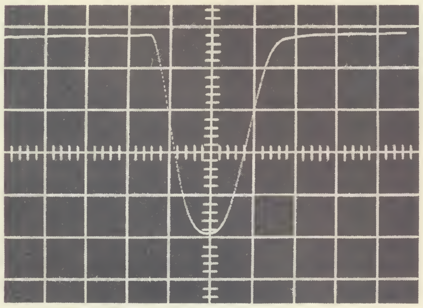
Dual Output—Dual outputs on each driver permit it to serve effectively as two drivers in many applications. Delay, width, rise time and fall time are identical at each output, while current pulse amplitude from each output is independently and continuously variable from 50 ma to about 600 ma. A front panel switch busses the two outputs internally permitting one of them to develop the full rated 1 ampere output. One advantage of the split output is the lower source capacitance available when operating at current amplitudes of less than 500 to 600 ma. In coincident-current applications Output A can drive an X-axis line, while Output B drives a Y-axis line. Set up time is markedly diminished since both outputs of the Model 1720 are automatically and precisely coincident.

High voltage output—A 60 volt compliance gives the 1720 a utility in driving inductive loads which cannot be satisfied in any other manner. From

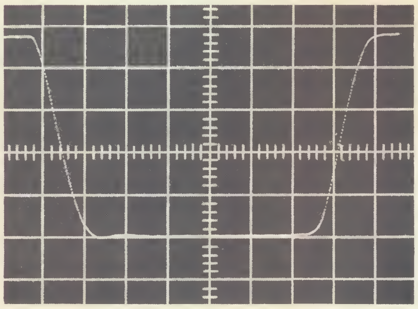
$$e = L \frac{di}{dt}$$

we can determine that voltage is a fundamental requirement in the effective high speed drive of significant inductances. The 1720 not only develops 60 volts in both the positive and negative polarities, but is also capable of withstanding back e.m.f. of that magnitude without damage.

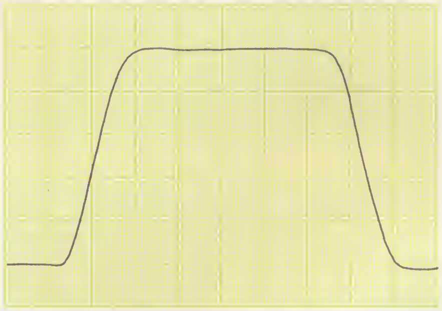
Automatic current limiting—Short circuit stable and open circuit stable, the 1720 is basically a rugged driver. Output current is automatically limited to a maximum average of 200 milliamperes (or 100 ma per output) . . . when this average current is exceeded trigger pulses to the driver are disconnected within 5 microseconds. Accordingly, practically any duty cycle operation can be achieved, up to about 95%, as long as average output current is limited to 200 ma.



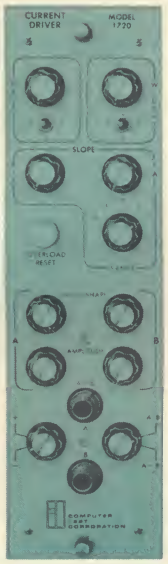
Oscilloscope Polaroid Waveform
Negative Polarity—Minimum Width
Hor: 10ns/div. Vert: 200ma/div.



Oscilloscope Polaroid Waveform
Negative Polarity
Hor: 10ns/div. Vert: 200ma/div.

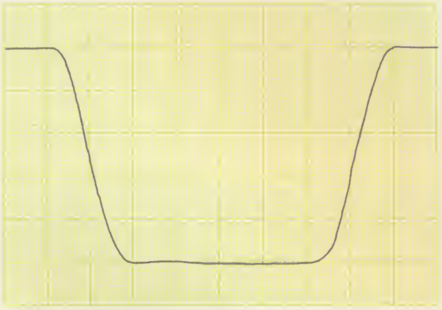


Actual X-Y Plotter Waveform
Positive Polarity
Hor: 10ns/div. Vert: 200ma/div.



Pulse shape control—A pulse shape control for each of the two outputs equips the driver with internal means for coping with small inductive loads. This control effectively permits removal of some of the higher frequency components developed at the leading, maximum amplitude corner of the current pulse, permitting compensation for small inductive loads without changing source resistance or reactance (Ideal for driving AQL type core handlers, core jigs, or production core handlers).

Low output capacitance—Low output capacitance is another and major identifying characteristic of the 1720 current driver. Careful output stage circuit design and the development of special semiconductor devices for this driver result in 50 pf maximum shunt capacitance at 1 ampere. Again, this makes the 1720 particularly capable of driving inductive loads since the ability to drive this type of load is severely limited by shunt capacitance.



Actual X-Y Plotter Waveform
Negative Polarity
Hor: 10ns/div. Vert: 200ma/div.

PULSE PARAMETER DEFINITIONS

% Linearity $= \dfrac{\delta_t \max \times 100}{T_R}$

% Corner Deviation $= \dfrac{I_C \times 100}{I_A}$

Rise Time $= T_R$

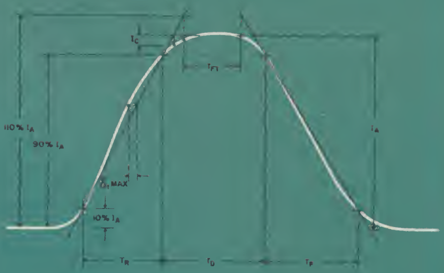
Fall Time $= T_F$

Duration $= T_D$

Flat Top Duration $= T_{FT}$

Amplitude $=$ I_A [measured at midpoint of T_{FT}]

Flat Top Distortion $=$ Deviation of pulse amplitude during T_{FT} as percentage of I_A



IMPORTANT FACTORS IN CURRENT DRIVER DESIGN

Most magnetic devices switch as readily from one state to the other with an exponential drive as with a linear drive. Indeed, the driving current waveform in practical applications of magnetic devices (memories, shift registers, etc.) are notably non-linear and do not have the precise waveform definition demanded of current drivers used in test applications. The reason for this is that repeatability and correlation of test data in test applications can only be achieved with pulses having well defined, unambiguous shapes. In this respect, the following design characteristics of current drivers are important:

Source impedance—Usually this term is considered in the static sense only. and most current driver designs call for high source impedance . . . that is, a *current source* characteristic. To be a proper current source, however, the source impedance must only be large compared to that of the load. This assures that current is determined by the source and not by the load. In particular, source impedance must be high compared to that of the load during the *switching interval,* to assure that current amplitude does not decrease during this time.

Source capacitance — Source impedance in the sense described above loses much of its significance for very fast rise time current pulses. This is because the output capacitance of the driver behaves like a low impedance shunt across the driver during the rise of the pulse, causing the driver to behave like a voltage source. Again, shunt capacitance directly limits the ability of the fast rise time driver to accommodate inductive loads. In the 1720, source capacitance is rated *worst case* at 25 pf per output. Since this capacitance is largely transition capacitance of the grounded base output stage transistor, it will decrease as voltage across the output stage is increased.

Rise time linearity—A linear rise current wave is demanded for practically all magnetics test applications to assure repeatability of test results and correlation of test data. This is because a linear or straight line is an unambiguous shape, permitting but one unique path between the two points which define its start and finish. Similarly, an infinite number of exponential lines may connect the same two start and finish points, but each will develop in the load under test a difference in load response which may be small or great, but usually significant enough to affect the reliability of test results.

Corner squareness—This is a characteristic which is usually overlooked in design and, indeed, selection of current drivers. It should not be overlooked, however, since the shape of the current pulse above the 90% amplitude point may be more significant in assuring test data correlation than is the linearity of the rise time. This is because many devices actually switch at or near the top corner of the drive pulse and any ambiguity in specifying or developing the pulse corner can result in large errors in load response. This loss of test data correlation can result even if the rise between the 10% and 90% points is a perfect straight line.

SPECIFICATIONS

MODEL 1720 CURRENT DRIVER

Pulse Delay	0-10 μs continuously variable.
Pulse Width	10 ns to 10 μs continuously variable.
Width/Delay Jitter	$\pm$1% or $\pm$30 ns max.
Width/Delay Stability	$\pm$3% or $\pm$30 ns max. for 8 hour period after warmup.
Number of Outputs per Driver	2—each output is essentially equal for equal load.
Output Polarity	Each driver may be selected to have either a positive or negative output.
Maximum Output Voltage	60 V.
Maximum Back emf	60 V.
Current Pulse Amplitude	50 ma to 500 ma each output, continuously variable. 100 ma to 1 amp with outputs bussed together.
Maximum Average Current	200 ma (100 ma each output) automatically limited.
Rise/Fall Time	10 ns to 500 ns, into 50 ohm resistive load at full current.
Linearity of Rise/Fall Time	$\pm$2% for rise/fall time greater than 20 ns. $\pm$10% for rise/fall time at 10-20 ns.
Flat Top Distortion	Negative: $\pm$1% max from nominal during T_{ft}. Positive: $\pm$2% max from nominal during T_{ft}.
Overshoot	1% max.
Corner Deviation	5% max. for $T_r > 20$ nsec.
Output Level	d-c referenced to ground.
Output Impedance	5 kΩ minimum.
Output Capacitance	25 pf maximum, each output.
Output Leakage Current	5 μa max. at 25°C.
Amplitude Stability	$\pm$0.5% maximum drift over 8 hour period after warmup.
Amplitude Variation with Duty Cycle	$\pm$1% max.

COMPUTER TEST CORPORATION
ROUTE 38 & LONGWOOD AVENUE, CHERRY HILL, NEW JERSEY

BULLETIN No. 65-F

CORE & MEMORY TEST EQUIPMENT

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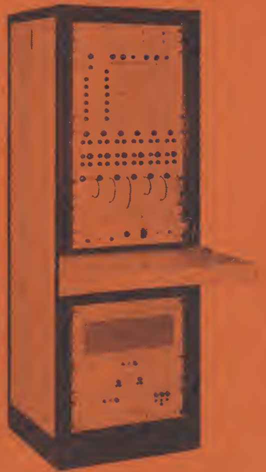
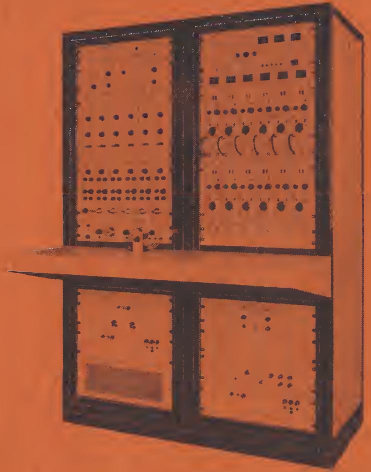
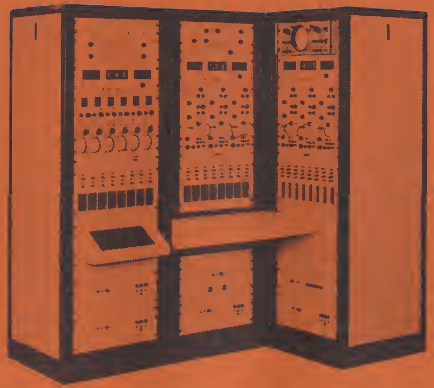


MODEL 1600 – PROGRAMMED CURRENT PULSE GENERATOR



MODEL 2050 – CORE TESTER



MODEL 2150 – PLANE TESTER

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